REMARKS

Claims 36-45 are pending in the application and stand rejected. In view of the remarks below, no amendments are considered necessary and none made.

The general issue is whether claims 36-45 are unpatentable under 35 U.S.C. §§ 102(b) and 103(a), in view of the prior art of record. Briefly, the specific issues ean be stated as follows:

A. In making the §102(b) rejection under Cameron, the Patent Office has given an unreasonably expansive definition to the claim term mechanically grasping that runs counter to a clear definition accorded within the specification, counter to the definition accorded in the wafer transport and chucking arts, and in violation of established case law.

B. The combination of Cameron and Bacchi fails to teach all elements of the claims sufficient to make a prima facie case in support of a §103(a) rejection. That is, in addition to the failure of Cameron to disclose a method for moving a plurality of wafers by mechanically grasping thc wafers, Bacchi fails to disclose detection of wafer contact pad displacement by detecting the position of the active contact point.

These issues will be divided into respective subsections and will address each of the grounds for rejection separately.

A. Rejection of the Claims Under §102(b) Is Unsupportable Because the Cameron Reference Does Not Teach The Step Of "Mechanically Grasping" According To A Reasonably Expansive Definition

Claim 36 is a method for moving a plurality of wafers using a robotic hand fitted with a plurality of end effectors with blades that mechanically grasp the wafers to secure each wafer to a corresponding blade. The robotic hand is then moved to a destination and the wafers released.

In making the rejection of claims 36-39 and 42-45 under 35 U.S.C. §102(b) as being anticipated by Cameron, the Patent Office has given an unreasonably expansive definition to the claim term *mechanically grasping* that runs counter to a clear definition accorded within the specification, counter to the definition accorded in the wafer transport and chucking arts, and in violation of established case law.

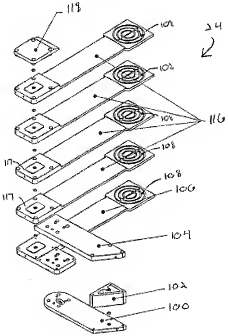
Case law is fairly specific on how claim language is to be interpreted during prosecution. "Words in a claim are generally given their ordinary and accustomed meaning unless the inventor chooses to be his own lexicographer in the specification." *Lantech, Inc. v. Keip Mach.*

Co., 32 F.3d 542, 547, 31 USPQ2d 1666, 1670 (Fed. Cir. 1994). "In examining a patent claim, the PTO must apply the broadest reasonable meaning to the claim language, taking into account any definitions presented in the spccification." *In re Yamamoto*, 740 F.2d 1569, 1571, 222 USPQ 934, 936 (Fed. Cir. 1984). The Federal Circuit cautions, however, that the PTO is not to erroneously construe the claims (as was the case in *Baker Hughes*) where such construction was "beyond that which was reasonable in light of the totality of the written description." *In re Baker Hughes, Inc.*, 215 F.3d 1297, 55 USPQ2d 1149 (Fed. Cir. 2000).

The Examiner has committed the same error as noted in the *Baker Hughes* case by applying a definition to "mechanically grasping" that is beyond that which is reasonable in light of the totality of the written description. To quote the Examiner from the Final Office Action:

> Cameron discloses mechanical grasping encompassing more than vacuum, e.g. an end-effector, first arm, second end effector, robot body, wafer holders, and vacuum opening which grasps via drive motor and shaft 74, 76 and pivot mechanism 70.

One skilled in the chucking arts would recognize, however, that the Cameron substrate batch loader instead teaches a vacuum chucking system. Figure 6 of Cameron, shown to the right, illustrates a multiple substrate batch loader 24 in accordance with an embodiment of the Cameron invention. The device includes a first arm connector 100 for connection with the first arm 22. An elevated base member 104 is positioned on the stand-off 102. A first paddle 106 is positioned and secured between the first arm connector 100 and the elevated base member. The first paddle 106 includes a ***vacuum aperture 108***, which operates in the manner described with respect to the vacuum aperture 98 of paddle 96 (that is, "establishes suction that secures a substrate to the paddle 96." Cameron, page 5, lincs 19-20)



Cameron Figure 6

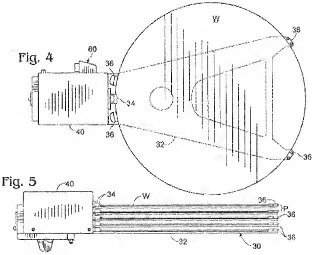
The Examiner appears to state that because Cameron includes mechanical systems (*e.g.*, drive motors), that this brings Cameron within the definition of "mechanically grasping" as

called for within the claims. Appellant asserts, however, that such a broadly construed definition runs counter to (1) a clear definition accorded within the specification, (2) to the definition accorded in the wafer transport and chucking arts, and (3) established case law detailing the proper interpretation of claim terms. The Examiner, in fact, provides no support why such an interpretation is reasonable in the mechanical arts, provides no support why such an interpretation is reasonable in view of the totality of the written description, and provides no support why such an interpretation is in accordance with the ordinary and accustomed meaning of the word "mechanically grasping." In other words, the Examiner has failed to uphold the rigor proscribed by the Federal Circuit in *Lantech*, in *Yamamoto*, and in *Baker Hughes*.

Appellant next examines what is stated in the specification about the limitation "mechanically grasping." Claim 36 recites the step of *mechanically grasping a selected number of wafers by a corresponding number of blades....* In describing the disclosed robotic hand, Appellant expressly states the following:

> "mechanically" grasping refers to wafer engagement by other than by application of pneumatic force directly to a surface of a wafer.
>
> (Patent Application, page 3, lines 6-8)

The present invention acts to mechanically grasp the wafers using wafer engaging pads 34 as shown in the patent application that act to mechanically grasp peripheral portions of the wafer. That is, the wafer engaging pad moves relative to other pads (*e.g.*, wafer rest pads 36) to clamp the wafer between the two so that a bias force is applied to edges of the wafer to keep it in place between the pads 34 and 36.



Current Invention FIGs. 4&5

Cameron does not teach a mechanically [wafer] grasping step as set forth in claim 36. Instead, Cameron utilizes a vacuum wafer grasping mechanism wherein vacuum suction is used to secure the substrate to the paddle. (Cameron, page 5, lines 17-20, 26-28, 30-31, page 6, line 1) This type of pneumatic force is explicitly excluded from the definition of mechanically grasping as set forth in the present application.

The disclosure within the specification is consistent with a generally understood definition of "grasping" as to seize or hold firmly as if with the hand. (*The American Heritage Dictionary of the English Language. 3rd Edition* 1996 – attached as Exhibit A) As the mechanical elements of Cameron perform no grasping function, they cannot be said to enable the mechanically grasping function within the Cameron. That is, excluding the pneumatic/vacuum force applied within the Cameron device, the wafers would simply fall out of the robotic drive arm if the arm were tipped or jostled because there are no elements that enact mechanical grasping. Consequently, the Patent Office fails to make a *prima facie* showing that the "mechanically grasping" step is disclosed within the Cameron reference sufficient to support a rejection of the claims under 35 USC §102(b).

Finally, the wafer handling and chucking arts recognizes several distinct methods for engaging a wafer during transport, including (1) gravity, (2) vacuum, (3) mechanical, (4) electrostatic, (5) electromagnetic, and (6) Bernoulli Chuck. *The End-Effector Bible,* published by FJA Industries in 2000 (3rd Ed.), portions of which are attached hereto as Exhibit B, is a reference in the wafer handling and chucking arts that cites these six types of "holding methods." Two of the methods, mechanical and vacuum, are described as reproduced below:

> Vacuum: Vacuum holding is a very common and popular method of temporarily securing a part to an end-effector for a short period of time. Flat surfaces are desired for vacuum holding in order to facilitate a vacuum seal. Therefore, parts having flat surfaces are candidates for this method. Debris ladened environments will prevent vacuum sealing and are not conducive to vacuum holding. While this method appears simple, the reader would be wise to investigate further. The details of this technology shall be discussed in full measure later in the text. The challenges of this technology are great and some of the implemented solutions are elegant.
>
> Mechanical: Clamping a part by mechanical means is a practical solution for many applications. One such application is holding parts in a vacuum chamber where the vacuum method of holding can not be utilized. The mechanical end-effector is usually a complex design and demands a higher cost. The potential for damage to the part being handled can be high for fragile parts.

Using one method over the other is more than simply a matter of design choice since the complexities involved are quite different depending upon which holding method is chosen.

Accordingly, vacuum retaining would not be considered equivalent to mechanical retaining as understood within the chucking arts.

The present invention is intended to address a method for using mechanical holding methods in order to address certain disadvantages of pneumatic systems such as the one disclosed in Cameron. Mechanical gripping is not found in Cameron. Instead, and as discussed above, a failure of the vacuum pressure in Cameron would allow the wafers to slide off of the pads 108 and out of the holder itself if the holder is tipped.

Furthermore, Appellant has determined that there are two significant advantages to using mechanical grasping over vacuum grasping in wafer handling process that argue against equivalence.

First, mechanical grasping introduces less contamination. The vacuum end-effector relies on the end-effector surface area in contact with the wafer to produce a lateral (parallel to wafer surface) friction force. This contact area and the associated micro displacement (vibration, slippage) produce particles on the backside of the wafer. When wafers are processed in wet tanks (cleaning processes) the backside particles can migrate to the front side where the chips are located. These particles would cause failures and decrease manufacturing yields. On the other hand, edge grip end effectors have minimal contact area and thus minimal particles are produced. Based on Appellant's measurements, an order-of-magnitude analysis shows that vacuum end effectors produce 10,000 particles and edge grip end effectors produce 10 particles per grip.

A second advantage of mechanical grasping over vacuum is that while edge grip end effectors have a known constant grip force based on the pneumatic force of the gripping actuator, vacuum end effectors grip (friction) force is less known or constant. The vacuum grip force is highly dependent on the surface roughness and the co-planarity of the end effector and wafer. The variability of the vacuum end effector grip force does not make the vacuum end effector a good candidate for multi-plane wafer motion. In addition, the vacuum end effector relies on the friction force between the end effector and wafer surface to produce a lateral (parallel to wafer surface) friction force. When the robot arm is accelerating in the horizontal plane with a horizontal wafer surface or when the robot arm is moving in the vertical plane with a vertical wafer surface, there are forces acting on the wafer may be greater than the lateral friction force, which could cause wafer slip and damage.

Since mechanical grasping is clearly distinguishable from vacuum grasping in the wafer handling process, and Cameron only teaches a vacuum wafer grasping mechanism, reconsideration by the Board and allowance of claims 36-39 and 42-45 are thus respectfully requested.

B. The Combination Of The Cameron And Bacchi References Fail To Teach Each And Every Element Of The Claims Sufficient To Support A Rejection Under 35 U.S.C. §103(a)

Claims 40 – 41 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Cameron in view of Bacchi, et al. Appellant respectfully disagrees with the rejection.

The combination of Cameron and Bacchi fails to teach all elements of the claims sufficient to make a prima facie case in support of a §103(a) rejection. That is, in addition to the failure of Cameron to disclose a method for moving a plurality of wafers by mechanically grasping the wafers, Bacchi fails to disclose detection of wafer contact pad displacement by detecting the position of the active contact point.

Claim 40 recites that the step of "sensing the presence and position of wafer" comprises "detecting a displacement of a wafer contact pad when said wafer contact pad contacts a wafer peripheral zone." Claim 41 recites that the optical sensing of wafer step comprises optically detecting a displacement of the wafer contact pad when said wafer contact pad contacts a wafer peripheral zone. Examiner alleges that Cameron discloses position and presence sensors and Bacchi discloses the step of sensing the wafer pad displacement.

Upon careful review of the prior art, it is clear that Cameron in view of Bacchi does not teach detection of wafer presence and position via wafer pad displacement as recited in claims 40-41.

The sensor in Cameron is noted on page 6, line 32 as an "object sensor 58" and is adapted to detect presence only. Furthermore, the Cameron sensor is associated with presence within the slots of a cassette (Cameron, p.6, ln. 33) as opposed to position on an end-effector as in the present invention where the displacement of a wafer contact pad is detected when the wafer contact pad contacts a wafer peripheral zone. (*e.g.*, claim 40) Presence of the wafer within a particular slot of the Cameron device cassette is further provided by use of a "vacuum sensor" (Cameron, p. 7, lns. 9-26). Again, position is not determined as called for within the present

claims. Accordingly, it would be inappropriate to read such a limitation within the Cameron reference.

The optical sensors disclosed in Bacchi are used to detect retracted, safe specimen loading/gripping and extended positions of the active contact point. (see, *e.g.*, Bacchi, Col. 2, line 22-24) The active contact point is movable between a retracted wafer-loading position and an extended wafer-gripping position to urge the wafer against the distal rest pads so that the wafer is gripped only at its edge or within the exclusion zone to reduce contamination. (see, *e.g.*, Bacchi, Col. 2, line 15-20). The active contact point disclosed in Bacchi does not perform wafer gripping functionality. Instead, Bacchi discloses that it is the proximal and distal rest pads 26, 24 that support and grip the wafer. (See, *e.g.*, Bacchi, Col. 2, lines 10-15)

Again, and in contrast to the teachings in Bacchi, the wafer contact pad recited in claims 40-41 is structured to serve the wafer grasping function. (Patent Application, page 3, lines 17-18, page 2, line 26-29)

Since the active contact point disclosed in Bacchi serves a distinct function from that of the wafer contact pad recited in claim 40 and 41, detection of the positions of the active contact point is not the same as the detection of wafer contact pad displacement. Thus, Bacchi does not disclose detection of wafer contact pad displacement by detecting the position of the active contact point.

In neither Cameron or Bacchi, therefore, is there a suggestion to combine the optical detection of the active control points of Bacchi with wafer detection feature from Cameron. Furthermore, there is no suggestion to use optical sensors to detect wafer pad displacement in Bacchi.

Care must be made when combining references.

The Federal Circuit has been consistent in reversing the PTO when a rejection is made on the basis of hindsight, that is when an Examiner rejects the application under 35 U.S.C. §103(a) grounds as obvious under a combination of two or more patents without any specific suggestion within the patents to combine the features. *In re Rouffett*, 47 USPQ2d 1453 (Fed. Cir. 1998), the Federal Circuit refused to uphold an obviousness rejection, even where skill in the art is high, absent the specific identification of principal, known to one of ordinary skill in the art that suggests the claimed combination.

The Federal Circuit reemphasized the care to be taken when combining prior art references in obviousness findings in *Ecolochem v. Southern Cal. Edison*, 56 USPQ2d 1065 (Fed. Cir. 2000), stating that such absence of evidence to combine prior art references "is defective as hindsight analysis." The Federal Circuit held similarly in *In re Kotzab*, 55 USPQ2d 1313 (Fed. Cir. 2000), reversing the PTO and stating that, "[i]dentification of prior art statements that, in abstract, appear to suggest claimed limitation does not establish prima facie case of obviousness without finding as to specific understanding or principal within knowledge of skilled artisan that would have motivated one with no knowledge of the invention to make the combination in the manner claimed."

Finally, the Federal Circuit has reaffirmed their view that the PTO used improper hindsight analysis to reject patent claims under §103(a) in the recent case of *In re Lee*, 277 F.3d 1338, 61 USPQ2d 1430 (Fed. Cir. 2002), stating that a specific suggestion in the prior art cited is required and not a simple citation to "common knowledge and common sense." *Lee* includes a tour-de-force of case law directed to the issue of combining references including those as follows:

- "The factual inquiry whether to combine references must be thorough and searching. . . . It must be based on objective evidence of record. This precedent has been reinforced in myriad decisions, and cannot be dispensed with." (*Lee*, 277 F.3d at 1343)
- "A showing of a suggestion, teaching, or motivation to combine the prior art references is an essential component of an obviousness holding." (quoting *Brown & Williamson Tobacco Corp. v. Philip Morris, Inc.*, 229 F.3d 1120, 1124-25, 56 USPQ2d 1456, 1459 (Fed. Cir. 2000)
- "Our case law makes clear that the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis if rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references." (quoting *C.R. Bard, Inc. v. M3 Systems, Inc.*, 157 F.3d 1340, 1352, 48 USPQ2d 1225, 1232 (Fed. Cir. 1998)
- "There must be some motivation, suggestion, or teaching of the desirability of making the specific combination that was made by the applicant." (quoting *In re Dance*, 160 F.3d 1339, 1343, 48 USPQ2d 1635, 1637 (Fed. Cir. 1998)

- "Teachings of references can be combined *only* if there is some suggestion or incentive to do so." (quoting *In re Fine*, 837 F.2d 1071, 1075, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988) (emphasis in original)

The Patent Office has failed to display the rigor required by the Federal Circuit holdings in demonstrating a suggestion within the art that the cited prior art references should be combined.

CONCLUSION

For the foregoing reasons, reconsideration and allowance of claims 36-45 of the application as amended is solicited. The Examiner is encouraged to telephone the undersigned at (503) 222-3613 if it appears that an interview would be helpful in advancing the case.

Respectfully submitted,

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grasp

grasp (grăsp) *verb*
grasped, **grasp·ing**, **grasps** *verb, transitive*

1. To take hold of or seize firmly with or as if with the hand.
2. To clasp firmly with or as if with the hand.
3. To take hold of intellectually; comprehend. See synonyms at apprehend.

verb, intransitive

1. To make a motion of seizing, snatching, or clutching.
2. To show eager and prompt willingness or acceptance: *grasps at any opportunity.*

noun

1. The act of grasping.
2. **a.** A firm hold or grip. **b.** An embrace.
3. The ability or power to seize or attain; reach: *Victory in the election was within her grasp.*
4. Understanding; comprehension: *"only a vague intuitive grasp of the meaning of greatness in literature"* (Gilbert Highet).

[Middle English *graspen*.]

EXHIBIT A

The End-Effector Bible

THIRD EDITION

By: Frank J. Ardezzone
End-Effectors, Inc.

EXHIBIT B

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The End-Effector Bible

THIRD EDITION

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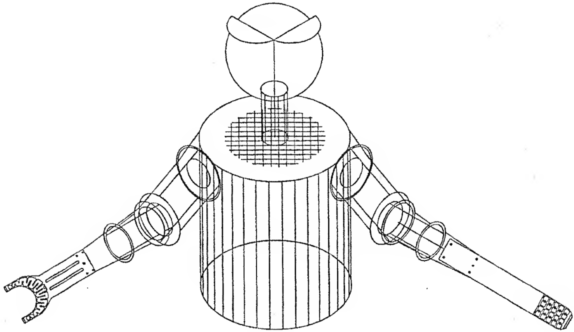

End-Effectors Inc.

Giving Robotics a Hand™

EXHIBIT B

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Acknowledgement

The information contained in this text is the result of work done by the author and his staff.

Numerous texts, hand books, research papers and data sheets have been referred to. Many hours of research, design, development and testing have been expended in pursuit of the information contained in this manual.

While many other persons have contributed in some form or fashion, I here list and thank the major contributors:

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Respectfully;
Frank J. Ardezzone
President, End-Effectors, Inc.

Notice

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Introduction

This text has been prepared as an informational tool. It's aim is to provide both general information on end-effectors and their relationship to robots as well as specific information to assist the developer of robotic devices in the design of end-effectors in general, and ceramic end-effectors specifically. We have attempted to provide all the information required to understand the role of the end-effector and the data to design them. However should additional information be needed, please call us and we will attempt to answer any remaining questions.

The reader should recognize that there are numerous applications using robotics. These extend from the very simple to the elaborate planet exploring types. It is not the aim of this text to elucidate all possible end-effector applications but rather to explain that end-effectors are a required part of every robot regardless of application. It is the object of the writer to discuss end-effectors as they relate to the electronics industry of the 1990s and beyond 2000.

The unique processes developed by End-Effectors Inc., have made the use of ceramic end-effectors economically feasible for manufacturers of automated process equipment. Fabrication limitations and cost considerations are no longer a cause for ruling out ceramic as a material of choice. New and unique processes now allow fabrication of parts which were not previously producable. In addition to the strength, rigidity, purity, wear resistance, high temperature operation and chemical resistance of ceramic, an additional factor of controlled electrical properties is available. This combination of properties and techniques can provide solutions for many problems which were here-to-fore, unsolvable.

Short of stating ceramic is "the" material of choice for end-effector construction, it is an excellent choice in many applications. In subsequent sections of this text we will discuss several materials and their properties. As important as the basic characteristics of a material are, another factor must also be considered: how materials fail. Failure characteristics can also determine what materials are suited to a particular application.

It is an understatement to say that there are hundreds of materials. The periodic chart of elements gives us building blocks from which thousands of compounds are created and adding combinations of materials and processes gives us millions of possibilities. Let it suffice to say that many, if not most, of the world's requirements can be met by common metals such as aluminum, brass, and steels. The modern high tech ceramics techniques can now meet the demands of the balance of the world's requirements. The implementation of new materials and processes allow the production of parts in a variety of ceramic materials and in configurations which here-to-fore could only be produced in metals.

Definitions

FORMAL DEFINITION

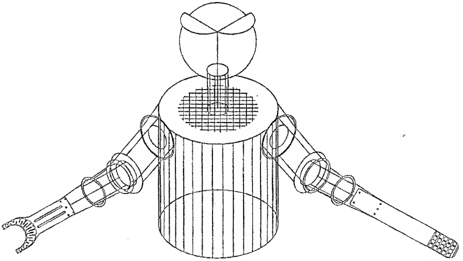
ROBOT: An automaton, specifically, a mechanical man.

END-EFFECTOR: An appliance to facilitate the capture, relocation or re-orientation of an object.

LAY DEFINITION

ROBOT: A tool for automation.

END-EFFECTOR: A robot's hand.



Applications

End-effectors have been used for many years. If we extend the definition and use it loosely we could say a fork is an end-effector, yes, chop sticks would also qualify. It was with the advent of industrial automation that end-effectors became widely used. They were first used to replace the meager strength of the human hand while humans still controlled positioning. This can be seen in early production lines where clamping devices would suspend heavy objects while men would position them. The clamping device was the end-effector. As machines got smarter, 1950s on, the holding devices came under the machine's control as opposed to the operator's control. This is evident in automated machine shop equipment where the machine moves the part it is fabricating and changes its own cutting tools. Next came automatic machines which controlled the end-effectors' position in space - any position.

The electronics industry took on a new look with the advent of semiconductors in the late 50s and 60s. Now the challenge was to hold and position very small parts. Robots were not fiction in a Hollywood script but a necessary element of the manufacturing business—not just electronic manufacturing, all manufacturing — especially automobiles. As robots were developed for all areas of manufacturing, so too were different types of end-effectors because of the need to hold a variety of parts under a variety of conditions. The cleanliness required in the electronics industry as well as a hostile environment of high temperature and chemicals favored robots over humans. The automation of the semiconductor electronics industry made end-effectors a crucial handling tool, requiring a highly sophisticated fabrication technology. End-effectors are now an integral part of robotic equipment used in the fabrication of many components for numerous industries throughout the world.

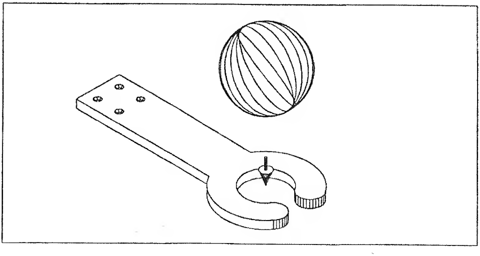
The handling of data disks and semiconductor wafers represent major industrial applications for end-effectors. The handling of glass plates is rapidly increasing as flat panel display production increases. It is safe to say that the automation of industry will continue to grow and the need for automatic handling of products shall also increase. End-effectors will both increase in size and decrease in size, this to accommodate the requirements of industry. They will be found in every area of industry as well as the medical industry where they will be employed to save human life.Thus, the need for end-effectors will grow and the engineering expertise necessary to fabricate them will require increasingly greater ingenuity and sophistication.

Holding Methods

Industry has held parts in position to perform manufacturing processes for many years. This can be done by a holding device such as a vise. In the robotic world there is an added factor to that of holding, it is mobility. The ability to hold a part and still have the mobility to position to precise locations defines robotics. This operational requirement has fostered the use of the following holding methods:

1. Gravity: Gravity can provide a means for holding a part while handling. Gravity is utilized with a holding fixture which provides a shape that permits the part to securely <u>nest</u> in the end-effector.

Gravity holds part in nest.



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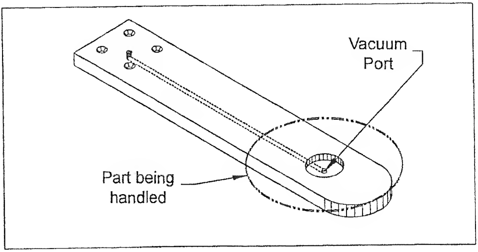
2. Vacuum: Vacuum holding is a very common and popular method of temporarily securing a part to an end-effector for a short period of time. Flat surfaces are desired for vacuum holding in order to facilitate a vacuum seal. Therefore, parts having flat surfaces are candidates for this method. Debris ladened environments will prevent vacuum sealing and are not conducive to vacuum holding.

While this method appears simple, the reader would be wise to investigate further. The details of this technology shall be discussed in full measure later in the text. The challenges of this technology are great and some of the implemented solutions are elegant.



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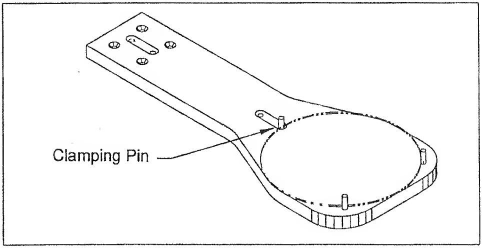
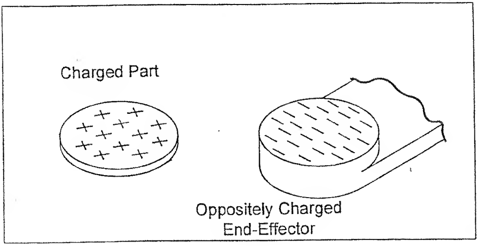
3. Mechanical: Clamping a part by mechanical means is a practical solution for many applications. One such application is holding parts in a vacuum chamber where the vacuum method of holding can not be utilized. The mechanical end-effector is usually a complex design and demands a higher cost. The potential for damage to the part being handled can be high for fragile parts.

Mechanical pressure from actuator pin clamps part in place.



4. Electrostatic: The electrostatic holding method is applicable when the parts being handled will not be damaged by an electrostatic charge and are light in weight. This method is particularly well suited for vacuum chamber use.

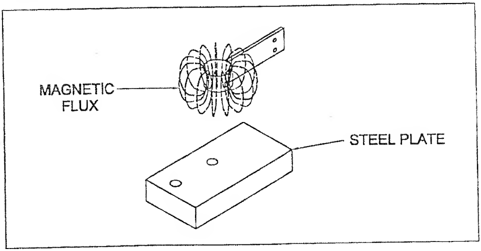
Electrostatic charge holds part in place.



5. Electromagnetic: The electromagnetic holding method has been used for many years in numerous industries. A primary requirement for the employment of this method is that the part will be captured by a magnetic field. This generally means that this method is limited to ferrous materials.

The holding power of the magnet is directly related to the magnetic flux density which can be varied by increasing or decreasing current flow for a particular electro-magnet design.

Electro-magnetic flux holds part in place.



6. Bernoulli Chuck: Daniel Bernoulli was a Swiss scientist who lived from 1700 to 1782. He discovered that gases moving through a tube with a restriction must speed up at the point of the restriction. It became obvious to him that if the gases increased in speed they must decrease in pressure in order to conform to the formula F = m x a. The venturi was thus invented and this principal is responsible for non-contact holding methods used for light weight parts.

There are many configurations which will produce the desired holding effect. This drawing is a diagramatic representation.

Balanced high and low pressure holds part in place.